

## **ADEQ Response to “Exposure Modeling Proposal for Identifying Hazardous Air Pollutants Sources Categories Under A.R.S §49-426.05(A),” dated October 19, 2005**

The following addresses the “Exposure Modeling Proposal for Identifying Hazardous Air Pollutants Sources Categories Under A.R.S §49-426.05(A)” document dated October 19, 2005 prepared by Patrick Allen Ryan, Ph.D.

Dr. Ryan proposes theoretical approaches to evaluating human health exposures but does not provide a clear methodology for conducting extensive studies, and how to analyze and use the results of these studies, or provide any estimate on the costs to taxpayers for conducting such studies. In addition to the potential hundreds of thousands of dollars per source category that would be required, the suggested approach is contrary to the requirements of the State law. It would appear that the procedure is designed to assure that no category of sources of HAPs is ever listed and required to install reasonably available controls technology (see Figure 1-1 on p. 1-3).

One of the major premises for the suggested method is based on a selective reading of the definition of adverse health effects found in ARS §49-401.01(2), which requires skipping over a key phrase in the definition: “‘Adverse health effects’ means those effects that result in *or significantly contribute to* an increase in mortality ...” (emphasis added to ignored phrase). Further, the document falsely ascribes quotes Weston Solutions, Inc. (Weston) and/or ADEQ. The words “potentially result in adverse effects” and “result in risk of adverse effects” never appear in any ADEQ documents or presentations regarding the modeling approach used for the analysis previously conducted for ADEQ by Weston.

As with previous documents submitted by Dr. Ryan, he misuses source documents by mischaracterizing the authority of the sources, and taking source material out-of-context. For example, he references as EPA guidance on modeling HAPs, “What Human Exposure Data and Models are Available?” (Özkaynak, 2002<sup>1,2</sup>) is not an EPA guidance document and the presentation is taken out of context by the AMA. The reference is to a presentation made in 2002 (according to the date of the document) by Halûk Özkaynak with EPA’s National Exposure Research Laboratory. An email from Mr. Özkaynak stated “The list of models shown were examples of certain types of models and not intended to be an exhaustive list. My focus then was on listing more detailed models rather than screening level models at that time.” (Eldridge, 2005<sup>3</sup>). Dr. Ryan erroneously references this document in his document as if it were EPA policy when it clearly was a general non-policy presentation made by an EPA staff member that was posted to the internet and **not EPA policy**.

In section 2.2.2 Dr. Ryan points out that the modeling should consider dry and wet deposition. To properly use the ISC model to determine dry and wet deposition, considerable information is

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<sup>1</sup> Özkaynak, H., J. Burke and S. Graham, 2002. What Human Exposure Data and Models are Available? Web site: [www.EPA.gov/OSP/presentations/airtox/ozkaynak.pdf](http://www.EPA.gov/OSP/presentations/airtox/ozkaynak.pdf).

<sup>2</sup> Note that Dr. Ryan’s document this was referenced as being published in 2005 when in fact it was a presentation made in 2002.

<sup>3</sup> Personal communication between Mr. Kevin Eldridge and Haluk Ozkaynak, 15 September 2005.

required regarding particle sizing, etc. that is not normally readily available. The magnitude of the effects of dry/wet deposition is heavily dependent on the exact particle size distribution, particle density, source characteristics, meteorology, and other variables. In addition, if deposition is occurring near a facility, these materials would be accumulating in the environment, be re-entrained and be re-introduced to the ambient air and enter the body through different pathways not considered by the ADEQ analysis. The time and resources needed to conduct a dry/wet deposition analysis for the facilities modeled by ADEQ would be extensive, and be very costly. Not only would source specific information regarding particle size and distribution need to be collected but the meteorological data would need to be reprocessed. ADEQ agrees that the use of ISC with wet/dry deposition and depletion is appropriate in certain situations and would consider accepting this approach if it were proposed in a Risk Management Analysis (RMA).

In Section 2.3 Dr. Ryan states that “It is necessary to fund and collect source-specific activity pattern data, as none exist suitable for the Arizona HAP rule site-specific applications...that is what A.R.S. §49-426.05(A) appears to contemplate.” Dr. Ryan proposes the use of global positioning system (GPS) tracking units; in essence, using the same types of devices that are placed on convicted criminals to track their movements.

What is being proposed by Dr. Ryan would require several weeks or months and quite expensive without providing any indication on appropriate time frames or costs. Large costs would be associated with:

- Equipment,
- Study design,
- Labor requirements for conducting the study,
- Compensation to the public for participation,
- Analysis of data, and
- Incorporation of the results into an exposure model.

No where does he provide any indication that the approach is, in fact, feasible. Numerous logistical problems could delay or invalidate the completion of the suggested studies, including:

- The ability to find subjects willing to participate in such research, and
- Difficulties associated with collecting valid data from the GPS units, such as receiving/sending signals indoors, near power lines, and near cell phones (Elgethun et al., 2003)<sup>4</sup>.

EPA has stated “These studies also have demonstrated that time-activity pattern data developed from general population studies often have little scientific value in understanding the activity patterns and exposure of children.”<sup>5</sup> In a follow-up communication, ADEQ was provided examples of studies that have been funded and conducted for specific projects and scientific research. All of the examples, however, were designed to conduct basic academic research and not for regulatory purposes. Of course ADEQ would consider such a study if an applicant wished to propose one as part of the RMA.

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<sup>4</sup> Web site: <http://ehp.niehs.nih.gov/members/2003/5350/5350.html>

<sup>5</sup> Web site: <http://www.epa.gov/nerl/research/1999/html/g8-1.html>

In Section 2.3 Dr. Ryan states that ... “an assumption that the population is always outdoors and located at the property boundary of a facility, or inside the fenceline (sic), is so extreme and unrealistic that it does not even qualify as a worst-case assumption.” This statement, however, is provocative opinion and not supported by the analysis that follows. Dr. Ryan intentionally misleads the readers by making it appear that the ADEQ modeled every facility with maximum impacts at or inside the fence line. This is not true. Although the modeled impacts for many facilities were at 25 meters from the source, the maximum impacts at other facilities were modeled at up to 400 meters away. Clearly large populations could reside within a 400 meter radius of a facility. As a matter of fact, there are facilities in Arizona where residences exist within 25 meters from industrial facilities. ADEQ also wishes to point out that the regulations are intended to regulate modifications and new emissions of HAPs. There is no way for ADEQ to know in advance the proximity of residences to emission sources that are neither proposed nor in existence. Because similar circumstances occur today, it is imminently reasonable to presume that they could exist in the future.

In Section 2.5 Dr. Ryan states that the evaluation of outdoor concentrations is “another conservative assumption.” As he has done previously, he presents a figure from a newsletter published by the Lawrence Berkeley National Laboratory to support the claim that “measured indoor concentration was about 10% of that outdoors.” As he did in the technical and scientific comments dated September 9, 2005, he tampered the figure taken from the source which he cites. The entire page from the newsletter is contained on the following page. Enclosed in the red box is the portion of the graph from this newsletter presented by the Dr. Ryan. This intentionally misleads the reader instead of facilitating honest discourse. First, ammonium nitrate particles are not a listed HAP. Second, the portions of the figure intentionally omitted by Dr. Ryan show that indoor pollutant concentrations are relatively similar to outdoor concentrations for the other two pollutants studied. The entire graph shows that indoor carbon particulate concentrations had occasion to exceed the outdoor concentration. Particle-bound carbon is also representative of many of the compounds included in the HAP modeling analysis. Finally, many children and adults recreate outdoors, many Arizona households rely on evaporative cooling in summer, and children tend to spend more time outdoors than adults and breathe more air per unit of body mass than adults.

In addition, the Arizona statute requires analysis of ambient air not indoor air. Therefore, consideration of indoor air concentrations for listing source categories in the HAPs rule is irrelevant.

In summary, ADEQ disagrees that the suggested detailed and expensive method is required by Arizona law to be used as the basis for listing categories of HAPs sources required to install reasonably available control technology. While Dr. Ryan suggests a theoretical construct that would be rigorous from a scientific perspective, its practicality and applicability to the State HAPs program is dubious. If, indeed, it was contemplated that ADEQ would need to follow such a procedure, the Legislature would have approved the large number of necessary staff and appropriated substantial sums of money to assure that it would be implemented; which, they did not. Finally, the validity of the arguments being made is stained by his misuse of sources that he purports support the methods outlined in his document.

## Indoor Concentrations of Outdoor Aerosols

continued from page 1

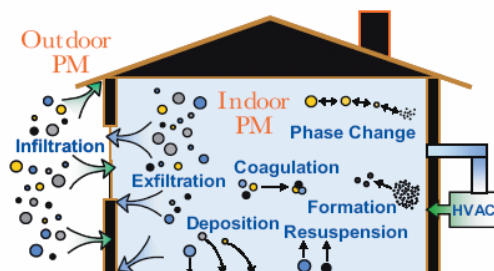


Figure 2. Schematic of the Clovis, CA research house showing the important processes that affect the indoor concentration of outdoor PM<sub>2.5</sub>.

### Field Study Methods

The field study collected time and chemical data on both indoor and outdoor concentrations of PM<sub>2.5</sub>, while ventilation, heating and cooling conditions were manipulated in the house. Measurements were made in October and December of 2000 and January of 2001. The house was unoccupied during these measurements to remove any confounding effects of indoor sources.

The research house was outfitted with a number of instruments to characterize particle size and chemistry simultaneously both indoors and outdoors, as well as meteorological variables including temperature and relative humidity. In addition, the house was instrumented to continuously measure ventilation rate. A new instrument, developed in part for this study, was key to characterizing the time-resolved behavior of important chemical species. Developed by Aerosol Dynamics Inc. (Berkeley CA), the instrument is an integrated collection and vaporization cell (ICVC) that enables measurement of concentrations of ammonium sulfate, ammonium nitrate, and carbonaceous aerosols with 10-minute time resolution.

### Variability in Indoor Aerosol Concentrations

Figure 3 shows results from the ICVC system, which show the variation in indoor and outdoor aerosol concentrations for a four-day period during the December measurement effort. The figure also shows the ventilation rate, indicated as air changes per hour (ACH). The results show that there is considerable variability in both the indoor and outdoor concentrations of all three species as well as in the magnitude of the difference between the indoor and outdoor concentrations.

In general, during periods of increased ventilation rate, the difference between the indoor and outdoor concentrations decreased. The most striking feature of Figure 3 is that the individual chemical constituents of PM<sub>2.5</sub> behave differently after entering into the residence. The difference between indoor

and outdoor ammonium nitrate concentrations is much greater than the differences measured for sulfate or carbon. Ammonium nitrate is a chemically active species that exists in equilibrium with gaseous nitric acid and ammonia. Upon entering the residence, the ammonium nitrate dissociated into its gas phase precursors, which were subsequently lost to the house surfaces by diffusion.

The differences in behavior between individual PM<sub>2.5</sub> chemical species and the dissociation of the ammonium nitrate aerosol illustrate that an exposure assessment based on total particle mass measured outdoors may not accurately represent actual human exposures to indoor particles of outdoor origin and may obscure the causal relationships involved. Ammonium nitrate is a significant outdoor pollutant in the Western United States. The extent to which it may or may not be a significant source of indoor exposure has important policy implications for control of sources that lead to ammonium nitrate formation. These results emphasize the need for chemical characterization of PM<sub>2.5</sub>, and further studies of the physical and chemical transformation processes influencing the indoor concentration of particles that originate outdoors.

—Melissa Lunden

For more information, contact:

**i** Melissa Lunden  
(510) 486-4891; fax (510) 486-5928  
MMLunden@lbl.gov

Nancy Brown served as principal investigator for this research, and Rich Sextro along with Susanne Hering (of Aerosol Dynamics Inc. of Berkeley CA) were co-principal investigators. Other EETD scientists who contributed to the project are Marc Fischer, David Littlejohn, Lara Gundel, Thomas Kirchstetter, and Ray Dod.

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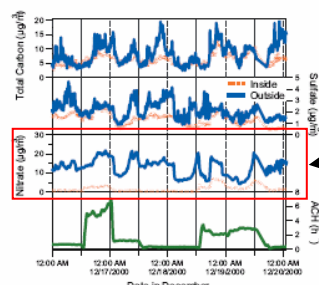


Figure 3. Data from the ICVC showing the variation in indoor (blue solid line) and outdoor (red dotted line) carbon, sulfate, and nitrate for a four-day period during the December intensive. The bottom plot shows air exchange rate as a function of time.

Portion  
of graph  
shown by  
Dr. Ryan

Full page from Lawrence Berkeley National Laboratory Newsletter  
(Lawrence Berkeley National Laboratory, 2003<sup>6</sup>)

<sup>6</sup> Lawrence Berkeley National Laboratory, 2003. Understanding the Indoor Concentrations of Outdoor Aerosols in Residences. Summer 2003, Newsletter. Web site: [http://eetd.lbl.gov/newsletter/nl14/nl\\_14.html](http://eetd.lbl.gov/newsletter/nl14/nl_14.html).